Commercial Aviation Safety Team and Joint Safety Analysis Teams

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ABSTRACT

The number of commercial airplanes in service will nearly double by the year 2015, going from about 12,000 airplanes today to over 23,000 in 2015. On a worldwide basis, the data suggest nearly a hull loss accident per week by the year 2015 at the current accident rate, which has plateaued over the last decade. Many ideas for enhancing safety focus on technology improvements to airplanes. While such improvements are important, it should be noted that their impact would not be significant unless they can be implemented on the existing airplane fleet. A large portion of the airplanes that will be operating in 2007 have already been built, and most of the rest have already been designed. The data show there are significant factors outside of the airplane design itself that influence the worldwide accident rate.

INTRODUCTION

On April 14, 1998, at Reagan National Airport in Washington, D.C., then-Vice President Albert Gore, Transportation Secretary Rodney Slater, FAA Administrator Jane Garvey, NASA Acting Deputy Administrator Jack Daily, and an audience of top aviation officials gathered to commit publicly to a new government/industry aviation safety initiative: **Safer Skies**. The Vice-President's statements that day established a public promise that the aviation industry and the U.S. government would conduct a decade-long effort to reduce the fatal accident rate in aviation by 80 percent by 2008.

The roots of Safer Skies were planted in 1995, in then-Transportation Secretary Federico Peña's decision to call for "zero accidents." These roots were nurtured in the reports of both the 1996 White House Commission on Aviation Safety and Security Chaired by Vice President Gore and the 1997 National Civil Aviation Review Commission (NCARC). The White House Commission and the NCARC both recommended that, to find a way to reduce aviation accidents, the FAA work with the airline industry to establish some form of strategic safety plan.

In 1997, at an NCARC hearing, FAA and airline industry representatives testified about how they were investigating the **root causes** of aviation accidents. The FAA Deputy Director of Aircraft Certification Service, Beth Erickson, testified for the agency: "We had learned from past efforts that safety improvements were better accomplished when we worked with competent aviation authorities--pilot unions, airlines, aircraft and aerospace manufacturers, and so forth--all pooling our expertise to come up with the best way to deal with safety issues. So we were very excited by the NCARC suggestion that the FAA work with the airline industry, especially using a data-based approach to discover what critical interventions would make a major difference in aviation safety." Erickson says that the White House Commission recommendations also helped the FAA decide that working with the airline industry was a more practical way to achieve safety goals.

Early in 1996, a broad segment of the aviation community established the Integrated Safety Strategy Team (ISST). After the NCARC issued its report, the FAA, NASA, and the DoD (represented by USAF) joined with the ISST to form the Commercial Aviation Strategy Safety Team (CASST) in October 1997. The group intended to combine the accident investigation research of the aviation industry and government.

COMMERCIAL AVIATION SAFETY TEAM (CAST)

John O'Brien, director of ALPA's Engineering and Air Safety Department, who served as a member of the NCARC and worked with CASST, explains that “CASST brought in

officials from the FAA and NASA to form the Joint Safety Analysis Steering Committee (JSASC), later to be renamed the **Commercial Aviation Safety Team (CAST)**. Throughout this transition, CAST members had decided there was considerable merit in this aviation industry/government process--especially one with recommendations and interventions based on data analysis." CAST set a goal to of reducing the overall fatal accident rate by 80 percent by 2007.

JOINT SAFETY ANALYSIS TEAMS (JSATs)

CAST soon developed a process that included **Joint Safety Analysis Teams (JSATs)**, whose members were technical experts from the parent CAST member organizations, and whose purpose is to analyze aviation safety data. The CAST process for defining and implementing a data-driven safety enhancement plan began with selection of the highest leverage areas of interest: Controlled Flight into Terrain (CFIT), Approach and Landing Accidents, Loss of Control, and Runway Incursion. CAST members include representatives from the FAA, JAA, FSF, ATA, ALPA, APA, RAA, NASA, and DOD (represented by the USAF), and airplane and engine manufacturers. Each JSAT's analysis is used to develop intervention strategies that become part of coordinated airline-industry/government safety action plans. CAST set up a Joint Safety Implementation Team (JSIT) to work on implementation of the JSAT developed interventions. This was a dramatic departure from past government/industry actions, because it provided an effective problem-solving mechanism to aid in implementation.

JOINT SAFETY IMPLEMENTATION TEAMS (JSITs)

JSATs are the first aviation industry/government bodies to have teeth, because strategies they develop are based on a government/industry consensus. These intervention strategies then are turned over to the **Joint Safety Implementation Team (JSIT)**, which develops plans for the aviation industry and government to implement these strategies. The JSAT combined the FAA's JSASC process with the industry group process of CASST to evolve a process that considers the facts of an accident, plus what went wrong and why, and suggests solutions and how to implement them. The process stipulates that the JSAT will not address the *feasibility* or costs of implementing the interventions. The JSIT is responsible for assessing the feasibility of JSAT recommendations and developing any appropriate implementation plans.

THE DEPARTMENT OF DEFENSE'S RISK

The Department of Defense (DoD) is a major stakeholder in the National Airspace System. The DoD's risk, however, is necessarily different for the majority of operations and risk tolerance is higher for military-unique operations, to include:

- Engine failures (fighters)
- Collisions with the ground
- Pilot-induced control loss
- Midair collisions.

Also, the USAF, over the past decade operated 14 civil-derivative and off-the-shelf aircraft in "commercial equivalent" roles. The human factors issues are very similar:

- Fatigue
- Safety Culture
- Human Error

METHODOLOGY

The various JSAT teams (Controlled Flight into Terrain, Approach and Landing, Runway Incursion, Pilot-Induced Loss of Control, and Weather) recognized that interventions are extremely limited in their potential to bring about a change unless they are based on a thorough understanding of the underlying causes. Accordingly, a the teams generated sets of supporting research recommendations. The JSAT methodology combines detailed case studies, a high-level data analysis, and expert judgement. The case studies employ an event-sequence analysis, while the high-level approach involves statistical data and data from other sources. Based on these different sources, the JSAT developed interventions that addressed specific case-study accidents. Each intervention was rated for three characteristics: power; confidence; and applicability. The JSAT then computed an "Overall Effectiveness" (OE) score or ranking, ranging from 0 to 6. OE scores primarily reflect the estimated effectiveness of each intervention in preventing the respective case-study accidents against which they were rated. JSATs recognized that singular and

isolated interventions generally are less effective in reducing accidents than are approaches that integrate related interventions.

The JSAT also included interventions that addressed organizational culture, systematic use of digital flight data, no-blame internal reporting systems, etc. Such interventions may not produce their full benefits by the 2007 target, or the analysis of past accidents may not adequately assess the full potential of some interventions to break complex causal chains in future accidents. Consequently, some recommended interventions, particularly those that address research and development, were not assigned OE ratings. Instead of OE ratings, later JSATs prioritized the research interventions.

The interventions that received the highest OE ratings provide the foundation for the recommendations, each of which calls for several actions by airlines/operators, manufacturers, regulators, or others. In addition, the recommended strategies include interventions that received lower OE ratings. Three additional data-related interventions are included in the recommendations due to their strong synergistic effects.

All recommendations require the active participation of regulatory authorities. Such participation may include developing technical standards, approving procedures, or overseeing implementation. In addition to the regulators, many recommendations identify other members of the aviation community that must take action if the recommendations are to be effectively implemented. The recommendation strategies are presented with their constituent interventions in a non-prioritized order.

The team analyzed the accident data set to develop interventions that would have worldwide application. Full implementation of recommendations will therefore involve manufacturers, operators, air traffic service agencies and regulatory agencies throughout the world.

INTERVENTIONS

The following is a synopsis of broad intervention strategies:

From the Approach and Landing JSAT:

1.) *Situational Awareness Technologies*
The industry should develop and implement technologies that enhance flight crew awareness of aircraft flight path and position geographically and relative to terrain.

2.) *Stabilized Approaches*
To address the problems of unstabilized approaches and loss of vertical situational awareness, the industry should develop and implement precision or precision-like approach capability (glidepath guidance) to all runways without established precision approach procedures.

3.) *Go Around*
To reduce the risk of accidents associated with unstabilized and rushed approaches, airline operators should:

- Establish policies, parameters, and training to recognize unstabilized approaches and other factors and implement a go-around gate system
- Institute a true no-fault go-around policy
- Incorporate, in initial and recurrent training, ways to recognize multiple cues that will require a go around
- Ensure that flight crews are trained to think in terms of “I will go around unless...,” rather than “I will land unless…”
- Enhance ATC training to emphasize dangers of rushed approaches and the performance characteristics of modern jet transports
- Base runway selection on the most current wind available

4.) *Standard Operating Procedures*

- An industry/government team should be established to develop a template for standard operating procedures best practices, including guidance on what SOPs should cover, development methodology, and how to train for, and monitor, procedural compliance.
- Research should be undertaken to better understand the underlying reasons/causes for procedural non-compliance

5.) *Safety Culture*

- Airlines/operators should and regulatory agencies must encourage a culture that enhances safety.
- Incorporate a company self-audit process and a cost analysis tool regarding the high

economic and psychological costs of accidents
- Emphasize safe arrivals over timely arrivals and discontinue on-time arrival tracking for airlines. Do not punish missed approaches. Base reward system on something other that completion of a route segment.
- Allow voluntary removal from flight status due to illness and/or emotional distress. Be sensitive about fatigue and circadian rhythm.
- Implement policies regarding crew pairing
- Airlines/Operators should establish a CRM training program and regulators should require and ensure the initial training is provided prior to line flying. Require recurrent CRM training.
- Parent Airlines/Operators should adopt a program to ensure the same level of safety in regional partners

6.) *Operational Feedback*
- To enable airlines/operators to identify safety issues and trends, monitor procedural compliance and initiate corrective actions prior to accident occurrence, the following interventions should be implemented:
- Airlines/operators should implement Flight Operations Quality Assurance (FOQA) programs
- Airlines/operators and regulators should implement a no-blame safety reporting and data sharing system with appropriate protection from litigation and prosecution.

From the Pilot-Induced Loss of Control JSAT:

1.) *Design Intervention Strategies*
Design interventions encompass strategies ranging from developing and expanding new technologies, such as flight envelope protection, to adapting and retrofitting older, proven systems to existing aircraft. Additional interventions attempt to deal with aircraft and systems certification. Team members expressed a great deal of concern that newer aircraft and systems, certified under derivative criteria, are not required to comply with higher standards of reliability and redundancy currently required of new designs. New technologies and existing technologies were also evaluated as to whether they should or could be adapted to existing aircraft.

2.) *Training Intervention Strategies*
In general, training history was very poorly documented in most of the accident data reviewed. There were several training or evaluation flight accidents reviewed as a part of the data set. In most instances involving training issues, team members developed interventions based upon their experiences with regard to best practices, which have proven effective in reducing or preventing accidents.

Since this was the Loss of Control JSAT, the training interventions focused primarily on preventing loss of control and regaining control. Several major carriers have recently introduced upset recovery training. However, the team felt that on a worldwide basis this continues to be a neglected area. The team also felt that current regulations and training regimes which focus on "approach to stall" inadequately prepare the pilots to deal with recovery from a full-stall condition.

Many of the accidents involved issues of automation, in which pilots were confused by the automation, did not understand or were not aware of what automation was doing or how to control the automation. Once control was lost, pilots did not clearly understand how to regain control of the aircraft through manual control, disabling the automation, or reestablishing automated control.

Pilot training was a topic in almost every accident analysis. There were two fundamental issues involved:

- Current simulators are limited in their effectiveness to train pilots to recognize and recover from a full stall.
- Pilots have not had adequate training to develop skills and confidence to recognize and recover from aircraft upset.

Simulator data packages do not include data representing portions of the flight envelope, including stall. This precludes realistic pilot training in the dynamics of stall and stall recovery. The team recommends that the JSIT evaluate expansion of the flight envelope data package and simulator capability in order to improve pilot training in the stall regime.

The team concluded that upset recovery training for pilots is essential to reduce the number of loss-of-control accidents. The team believes that

simulators can be used more effectively to develop skills and confidence for pilots to recognize and recover from aircraft upset. The team recommends that upset recovery training become a mandatory part of initial and recurrent pilot training programs.

- Stall Recognition and Recovery
- Upset Recovery Training
- Automation Training
- Instructor and Check Pilot Qualification and Training
- Improved Training, Policies, and Procedures
- Simulators

3.) Practices, Policies, and Procedures Intervention Strategies
A large number of interventions deal with practices, policies, and procedures. Few of the accident reports contained specific information regarding this topic area. The team members had to rely on their experience to provide interventions that reflect the best practices in the industry. The team recommends that accident investigation reports should explicitly address practices, policies, and procedures.

Standard Operating Procedures (SOP) either did not exist or were not followed in many accidents. Assuming pilots do not intentionally violate existing SOPs, it is crucial to understand the underlying cognitive processes contributing to procedural non-compliance. Intervention #204 calls for important research aimed at understanding this issue.

In most accidents involving automation, there was an absence of an automation policy. Pilots became confused about the automation and did not have any policy of monitoring or disengaging that would have helped them prevent the accident. In many cases, airlines have automation policies that include phrases like "Use the appropriate level of automation," but they provide no guidance or training as to how to decide what the appropriate level of automation is for a given set of circumstances. This situation leads to pilot confusion and inaction and contributes to automation-related accidents.

There were several cases where service bulletins had not been implemented or where they had been implemented and there was no information provided to the pilots. There were also several cases where the information provided by the manufacturer had not been incorporated into the operating procedures of the airlines. The team recommends that the JSIT identify and implement best practices for coordination between regulators, manufacturers, and operators that ensures critical safety information is distributed and implemented in a timely fashion to those who need it.

There continues to be an industry-wide problem of pairing minimally qualified pilots. It was the opinion of the team that this issue needs continual oversight by both operators and regulators.

- Standard Operating Procedures
- Automation Policy
- Integration of Manufacturer Procedures Into Flight Operations
- Crew Qualifications
- Currency and Accuracy of Information
- Service Bulletins
- Manuals

4.) *Data Intervention Strategies*
There are a limited number of intervention strategies related to data collection. The analysis of the team was complicated by the fact that many of the accident aircraft had no or limited data recording available. In many of the accident aircraft, the data recorders were not functioning or the data available was so limited that it was almost useless.

The team also recommended statutory support for ongoing analysis of data from nonvolatile memory systems, such as FOQA or BASIS, and self-reporting programs, such as ASAP or ASRS, to identify and eliminate problems before they result in accidents. These programs need to be protected by statute to ensure that they can fulfill their purpose of sharing safety data and identify precursors to accidents in a non-punitive atmosphere.

5.) *Regulatory Intervention Strategies*
Almost every intervention assumed a regulatory role. Effective implementation of any particular intervention will require active regulatory participation if not direct implementation responsibility. The regulatory interventions encompass both the "rules" and the oversight responsibility of the regulatory agencies on a global basis:

- Regulations, Rules, and Advisory Circulars
- Certification
- System Reliability
- Training
- Oversight
- SOP
- Airline Operations
- Currency and accuracy of Information

CONCLUSION

The CAST and JSATs illustrate the ability of industry and government to work together effectively with the goal of increasing global aviation safety.